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(54) **MICROCHIP AND WEDGE ION FUNNELS
AND PLANAR ION BEAM ANALYZERS
USING SAME**

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(58) **Field of Classification Search** 250/281,
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250/293, 396 R, 397

See application file for complete search history.

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(57) **ABSTRACT**

Electrodynamic ion funnels confine, guide, or focus ions in gases using the Dehmelt potential of oscillatory electric field. New funnel designs operating at or close to atmospheric gas pressure are described. Effective ion focusing at such pressures is enabled by fields of extreme amplitude and frequency, allowed in microscopic gaps that have much higher electrical breakdown thresholds in any gas than the macroscopic gaps of present funnels. The new microscopic-gap funnels are useful for interfacing atmospheric-pressure ionization sources to mass spectrometry (MS) and ion mobility separation (IMS) stages including differential IMS or FAIMS, as well as IMS and MS stages in various configurations. In particular, “wedge” funnels comprising two planar surfaces positioned at an angle and wedge funnel traps derived therefrom can compress ion beams in one dimension, producing narrow belt-shaped beams and laterally elongated cuboid packets. This beam profile reduces the ion density and thus space-charge effects, mitigating the adverse impact thereof on the resolving power, measurement accuracy, and dynamic range of MS and IMS analyzers, while a greater overlap with coplanar light or particle beams can benefit spectroscopic methods.

32 Claims, 17 Drawing Sheets

